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SANITIZED VERSION OF MONTHLY PROGRESS REPORT FOR SEPTEMBER 1946

(SANITIZED VERSION OF CRD DOCUMENT # KZ-952)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

December 21, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

CARBIDE AND CARBON CHEMICALS CORPORATION

PROCESS DIVISION

PROCESS DESIGN AND DEVELOPMENT DEPARTMENTS

Date: October 15, 1946

MONTHLY PROGRESS REPORT FOR SEPTEMBER 1946

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THEORETICAL ANALYSIS DEPARTMENT

MONTHLY PROGRESS REPORT FOR SEPTEMBER 1946

G. A. Garrett

HE - 21 Review of Technical Data

The section on nomenclature and definitions has been rewritten in what is expected to be the final form. This form lists the nomenclature and definition of terms which are to be used in the succeeding section of the manual. The topics are listed according to the following headings:

Barrier Theory
Stage Theory
Cascade Theory
Barrier Types
Pump Types
Equipment Names
Valve Types
Seal Types
Instrument Types

For the first three items, it has been decided to eliminate the British and SAM nomenclature and provide one system of standard nomenclature which will be used throughout the manual. This system is the one which is now more commonly used.

Barrier types and Pump types have been mentioned in previous progress reports, and there are no substantial revisions.

Equipment names include a list and description of those pieces of equipment which are closely linked with the operation of a diffusion cascade. Some schematic sketches will be included.

Valve types, Instrument types and Seal types include a listing of the symbol or abbreviation used to refer to each individual type of valve, instrument and seal.

Review of the existing Kellex Technical Data has begun. Some of these data are being eliminated on the basis that they are of no value in studying the present UF_6 diffusion plant.

HE - 2 Work Conducted at Request of Operating Departments

1. Separation Performance Studies

a. Differential Changes in Plant Constants

A report has been issued on a new series of differential plant constants similar to those appearing in Report 2.4.2, "The Effect on Product Purity of Differential Changes in Plant Constants". This report presents the constants $\Delta P/P/\Delta N$, $\Delta \Psi/\Delta N$, $\Delta N/\Delta L$, $\Delta P/P/\Delta \Psi/\Psi$, and $\Delta P/P/\Delta L/L$, for all sections of the combined plant at a product purity equal to 412000. The factors

enable a calculation to be made of the change in product rate at constant product purity that results from a small change in one or more of the plant constants such as psi, interstage flow, or stream efficiency.

b. Plant Output with Depleted Feed

A report has been issued on the "Predicted Productivity with Depleted Feed Materials". In this report curves were presented showing the X output and waste concentrations of the combined plants under the following conditions:

(1) No normal feed.

(2) Feed concentrations of 33046% (K-27 Waste), 33056% (K-25 Waste), 33070% (S-50 Waste).

(3) Feed rates from 1600 to 3700 kgm T per day.

This report was used to study the feasibility of using these depleted materials as feed to produce 411500 and 412500% X material. 3600 Kgm T/Day was assumed to be the maximum amount of waste material that could be fed into K-27 with present facilities.

At a feed rate double the present normal feed rate, a feed concentration of 33056 would produce 85% as much material at 412500 as normal feed at a normal rate.

A similar study is being made for production at 46000.

c. Production of Plant

Work has been completed on the combined operation of the K-25 and K-27 plants at a feed rate of 1300 Kgm T/day and with restricted optimum pressures. The following best estimates in terms of production at 46000 were obtained for production at the listed product concentrations:

46000 - - - - 100%

49000 - - - - 97%

411500 - - - - 84%

412000 - - - - 82%

412500 - - - - 74%

412800 - - - - 62%

Enriched X inventories and waste concentrations were also calculated.

[redacted]

2. Engineering Data

a. Correlation of Psi Values and Flows with Pressure

Interstage flows and psi-values as a function of tails pressure were calculated for each section of the plant at frequencies of 55, 60, and 65 cycles per second. The results were adjusted to plant data and summarized in the form of equations relating the flow and psi value to tails pressure. The results present the present best estimates of psi-values, but more complete data will probably require revisions of these values.

b. Size Factors

A report was issued on building size factors, cell size factors, and building relative inventory factors for 60-60 cycle operation of K-309 and K-301. Values for 65-65 cycle operation were prepared for K-304.

3. Statistical Studies

a. Synthetic Standards

The precision with which the weight ratio of U-235 to U-238 can be known has been investigated. The standards which are of greatest interest at the present time are waste and normal, whose attainable precisions are $\pm$ 0.13% and $\pm$ 0.18% respectively.

c. Change of Cascade Inventory

Only the change in inventory is important in the cascade material balance. These changes are in general small. It is, therefore, easier to compute the change in inventory (a small number) which depends on changes in the seven variables, than it is to compute two complete inventories. This method has the further advantage that the relative importance of the different variables can be more easily seen. It appears that very few significant figures (in most cases only one or two) need be carried in the building calculations.

[redacted]

[redacted]

d. On Least Squares Lines

The following problems have been solved:

(1) When the relationship between y and x is known to be linear, and when the precision of measurement of y is constant, at what values of x should y be measured to obtain

(a) maximum precision of estimate of slope?

(b) maximum precision of extrapolation?

(2) When the relationship between y and x is known to be linear but the precision of measurement of y is variable, at what values of x should y be measured to give (a) or (b) as above?

The solutions, too complex to summarize here, are given in the forthcoming report No. 2.31.2.

Reports Issued:

1. "Revised Size Factors", 2.26.3, V. W. Thompson, 8/27/46

2. "Production at 12000% Product Purity with Reduced Inventories", 2.8.10, E. S. Johanson, 8/30/46

3. "Use of a 312 Building for Isotope Separation", 2.9.3, E. S. Johanson, 9/9/46

4. "Determination of Cascade Productivity and Consumption from Operating Data, 2.26.3, C. Daniel, 9/9/46

5. "Stage Properties of Section 310 with C-616 and G-74 Mixtures of 0, 10, and 25% G-74 at 50 Cycles", 2.23.7, W. S. Lenihan 9/5/46

6. "Predicted Productivity with Depleted Feed Materials", 2.9.1, P. Wood, 9/23/46

7. "Predicted Performance of Combined Plants at High Product Concentration", 2.8.11, D. Burton, E. Johanson and E. Usdin, P. Wood, 9/30/46

8. "A New Treatment of Steady State Enrichment Equations", 2.28.1, G. A. Garrett, 9/24/46

[redacted]

[redacted]

DESIGN AND DEVELOPMENT DEPARTMENT

MONTHLY PROGRESS REPORT FOR SEPTEMBER 1946

R. B. Korsmeyer

P. R. Vanstrum
A. A. Abbatiello

Compiled by: J. A. Martin

HE - 10 Development of a Dry Vacuum Pump

Approximately 90% of the detailed drawings of the dry vacuum pump have been completed.

HE - 13 Tests on Valley Iron Works (Type R) Pump

1. MFI/P-10 Impregnated Graphite Seals

The graphite seals impregnated with MFI 85%/P-10 15% had indicated an abnormally high leak rate after running the following hours:

G-74	107 hours
60 - 70% C-616	43 hours
Total	150 hours

Examination of the seals showed slight wear and C-616 discoloration but there was no apparent cause of failure.

They were reinstalled. The leak rate at a seal feed pressure drop of 0.50 psi was 0.0282 std.cu.ft./hr. They have run the following hours since reinstallation:

G-74	22 hours
60 - 70% C-616	150 hours
Total	172 hours

After 165 hours with a seal feed pressure drop of 0.50 psi, the leak rate increased to 0.25 std.cu.ft./hr.

2. Morganite/MY-3 Seals

The Morganite MY-3 seals were removed due to excessive leak rate after they had run the following hours:

G-74	169 hours
60 - 70% C-616	728 hours
Total	897 hours

[redacted]

7

It was observed that the seals showed only light C-616 attack and light wear, averaging 0.0007 inch worn from the running surfaces. The seals had had very little play to allow for wear when installed. Thus the accumulation of a small amount of powder between the segments prevented the seal from contacting the shaft and is believed to be the cause of the excessive inleakage. The seals were cut down to allow more contraction and reinstalled. The leak rate on G-74 was 0.0412 std.cu.ft./hr. Since reinstallation, they have run the following hours:

G-74	22 hours
60 - 70% C-616	188 hours
Total	210 hours

The leak rate at present with a seal feed pressure drop of 0.50 psi is 0.213 std.cu.ft./hr. and with a pressure drop of 0.30 psi it is 0.1035 std.cu.ft./hr.

HE - 14 The Viscosity Seal Development Program

1.

2. Plant Investigations

Seal operating temperatures in sections 304 and 305 were investigated for a period of 70 days ending September 21. During this period the average temperature in 304 was 11°F. higher than in 305. This may explain the higher seal failure rate in 304 as compared with 305 since an 11° rise in temperature may be expected to increase the corrosion rate.

During the month a total of 121 seals of all types were removed from process and were inspected. The seals removed were classified according to the following categories:

Failed Parts Not Evident	36
Melted Solder	26
Heavy Wear & Corrosion	59

HE - 17 Recovery of C-616 from Conditioning Gases

Work on this account is being postponed pending possible revisions in the present unplugging method.

HE - 18 Development of Equipment for Recovery of "T" from Waste Process Material

1. Recovery of "T" from Carbon

The first run in the large furnace has been completed with a total of 700 lbs. of carbon having been burned (low assay material). The

results showed a loss of less than two pounds of "T" or 1.0% of the "T" in the carbon at the start. The T_3O_8 product contained only 0.1% carbon.

2. Recovery of "T" from Alumina

Production scale equipment is being designed for the leaching of "T" from alumina with mixed acids.

3. Recovery of "T" from High Assay Green Salt

Approximately 1000 gms. of T_3O_8 have been produced and the remainder of the 2170 gms. of Green Salt is being given final treatment.

HE - 22 Fabrication of MFP-10

All equipment has been installed in the new plastics shop.

A total of 2616 gms. of MFP-10 was molded for gaskets of various sizes during the month.

HE - 23 Pilot Plant

Construction work on the pilot plant has been completed with the exception of sheetmetal covering of the housing and painting. The plant is leak tight to specifications with the exception of the fifth (final) section.

HE - 24 Gas Bearing Blowers

1. 1200 CFM Loop

All component parts of the loop have been fabricated and work has been started on the erection of the loop. The coolant system is complete except for connections and instrumentation. The instrument panels are being fabricated.

2. CSV Life Test Loop

The loop and its coolant system is complete and layout drawings for the instrumentation have been submitted by the Instrument Division.

3. Bearing Tests

A new sleeve for the modified solid bearing has been made in the Machine Shop.

4. Services

The variable frequency electrical system has been completed. Several minor corrections in the wiring are now being made.

[redacted]

[redacted]

HE - 26 Consumption Studies

1. No. 3 Converters

Analysis of specimens from the No. 3 converters from which PG had been removed by high temperature C-216 treatment indicates that considerable "T" remains in the converter, particularly in the barrier.

2. Tails-Stream Dust Collector - K-311-1

It was placed on stream September 27th in parallel with the tails stream of stage 3, K-311-1-3. An estimated 2% cut of the gas stream is being filtered with no apparent interference to cell operation.

3. Surge Drum - K-312-2

The surge drum was opened and several samples consisting of a few grams of a gray-black, finely divided powder (a fraction of the total) were removed. Spectroscopic examination revealed the moderate presence of Al, Ni, and Mg, and the strong presence of "T". Direct analysis of the samples gave "T" concentrations ranging from 30% to 50%.

4. K-312-2-3 - Process Equipment

There have been obtained for surface analysis from K-312-2-3, two Whitehead converters, one Valley Iron Pump and one control valve. To date, one converter has been opened. A considerable quantity of gray-black powder was found collected in various locations within the converter and cooler and distributed as a loosely adherent powder layer on the barrier. Spectroscopic analysis, the only analytical data available to date, showed strong "T", and the moderate presence of Al, Ni, and Mg.

5. Consumption Test on Cell 12 - K-312-2

The low concentration dynamic consumption test (1.1% to 3.5% C-616) showed a consumption rate not significantly different from the test which was run with 100% C-616 (about 2.5 gms/cell/day).

HE - 27 Converter Unplugging Studies

Operation of the test loop was put aside pending immediate treatment of converters removed from the plant. See HE-2, paragraph No. 8, for results of this work.

HW -824 Work for Outside Parties

Two hundred boron carbide/polyethylene plastic discs were produced in accordance with the following specifications:

Wt. of B_4C/disc	235 gms.
Wt. of Polyethylene/disc	166 gms.
Diameter of disc	5" + 0.000 - 0.005
Thickness of disc	0.8" to 1.0" + 0.000
Coated with varnish - hard finish	

[redacted]

[redacted]T

HE - 2 Work Conducted at the Request of Operating Departments

1. Modification of Bijur Oil Pump

Further revisions were made to the modified Bijur pump after test data was obtained. It was found that the forced lubrication to the thrust bearing (one of the original revisions) should be omitted, and that a Gits oil seal should be substituted for the carbon seal.

2. Alterations of T_3O_8 Fluorinator for K-1301 Section

A report covering the design and construction of an experimental fluorinator with rotating cylinder is ready for distribution.

3. Fluorinator for T_3O_8 Containing Carbon

An experimental fluorinator for determining the maximum safe percentage of carbon that may be fluorinated with T_3O_8 has been designed and partially constructed.

4. Recovery of C-616 from C-816/C-616 Mixture

The fluorination of a trial batch from the 445 lbs. of sodium uranate mentioned last month produced TF_6 with less than 0.25% fluorocarbon.

5. Water Corrosion

Nine coolant coolers were replaced in the plant during September, seven in K-25 and two in K-27. These changes were made to determine:

a) the extent of corrosion and

b) the effect of the sludge deposits on the heat transfer.

On visual inspection the coolers from K-27 were found to have appreciably more deposit than those from K-25 but they also have less pitting than those from K-25. Pictures of these coolers were taken and the pit depths and shell thicknesses were measured. Several samples of deposits from both the shells and the tube bundles have been sent to the laboratory for analysis.

Preliminary data on the seven new coolers installed in K-25 show no appreciable increase in heat transfer over the old coolers. On the other hand, the two new K-27 coolers show a large increase in heat transfer over the old coolers as seen by the change in control valve positions and the water temperature increase across the coolers.

6. Recovery of Plugged Converters

Five converters were treated with C-216 in the K-1401 furnaces. A tabulation of the results is shown below:

[redacted]

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[redacted]

Converter	Barrier Type	Removed From	Plug %
C-227		305-3-3-6	29.4
C-706		305-12-7-6	69.8
D-402		306-1-2-1	64.2
D-409		306-1-2-3	67.8
D-157		3-6-7-12-6	24.7

The calculated C-216 plug (last column) is that which was added by the C-216 treatment Accordingly, the residual "T" plug would appear to be the difference between the C-216 plug and the final plug.

7. Testing of Stored Converters for Moisture Plugging

Four stabilized converters which had been in storage for 14 to 20 months were returned to the K-1401 furnaces to determine 1.) the degree of moisture plugging acquired in storage and 2.) the C-216 treatment required to regain the original conditioned porosity. The results are shown below:

Converter	Time in Storage, Mo.	Residual Plug, T.
A-178 *	3.23	-6.25
	17.40	
B-204N	14.67	-2.64
B-205N	14.67	+2.72
		+2.72
C-136 *	3.10	+2.17
	16.53	+0.83

[redacted]

8. C-616 Film Flow Studies

Construction of the B-14-S test loop has been completed.

9. MFL and C-2144 Requirements

A review of the MFL and C-2144 requirements was made based on Mr. M. Fortune's memo of July 5 and the several equipment changes that might be made to reduce the use of these oils. At the present rate of usage the supply of oil will last until July 1948. If the use of oil in the V. I. W. pumps can be eliminated by July 1947, the present stock of oil will last until December 1949. If, at the same time, the Beach-Russ and Stokes pumps can be replaced by a dry type vacuum pump the remaining oil would last an additional nine years.

10. Metal Wool Mist Filters

Several minor changes in the design of the metal wool mist filter have been worked out with the Plant Engineering Department in order to allow the installation of the filters with a minimum of change in existing piping.

11. Forced Ventilation of K-27 Stage Motors

Test ducts presently installed on the "B" pump motors in the escape alley of K-402-5 have proved effective in reducing the motor temperature approximately 15°F. This reduction, however, is not sufficient to permit safe motor operation at the stage pressures desired.

To utilize the air supply more efficiently, an auxiliary hood was designed to direct part of the air, issuing from the duct and deflecting off the back of the motor, into the front intake of the motor. This auxiliary hood has been tested and appears to provide about one-third greater cooling than the duct alone.

12. Revisions to the L-28 System

The following changes in the operation of K-1408 were proposed by the Cascade Service Department:

(a) The vent line on the L-28 tanks presently venting to the atmosphere be tied into the G-74 line to process, thus saving approximately 200 gallons of L-28 per day.

(b) The G-74 surge tanks be used as emergency converters by introducing L-28 into them and allowing normal vaporization to occur.

A stress analysis of the system affected revealed that in order to put change (a) into effect, only a minor change in the support of the process line at one point is necessary. In order to make change (b) it was found, from a safety standpoint, that one blow off valve in each of the two surge tanks and an expansion joint in the line leading to the tanks is necessary.

[redacted]

13. K-131 Floor Loading

A stress analysis was made of the floor structure in K-131 to determine if C-616 waste drums could be stored there. It was found that the steel structure would tolerate the load, but that the concrete panels would not. It was recommended that additional support be provided for the concrete. This has been turned over to the Maintenance Engineering Department for completion.

14. K-631 Floor Loading Under Waste Accumulators

An investigation was made to determine whether the waste accumulator drums in K-631 could be filled to capacity without endangering the floor structure. It was found that the load would be well within safe limits with the drums full of liquid.

15. Molecular Still for MFL and C-2144 Tailoring

The still has been set up and vacuum tested. Some minor electrical work and insulating must be completed before the still is placed in operation.

16. Special Test on P-10 Gasket

A P-10 gasket 1/2" O.D. x 13/32" I.D. x 1/32" thick was found to provide a tight joint when vacuum tested at the temperature of L-28. The test coupling was torqued moderately at room temperature before being cooled in L-28; no further torquing was required.

17. Gas Phase Fission Counter

The operation of the two counters at the top and bottom of K-27 has been transferred to the Process Operations Department. The 402-1 installation has operated for the past month with an estimated precision of ± 3.8% (95% confidence belt) and with an average bias from the laboratory analyses of minus 1.2%. The 402-9 installation has operated for the past week with an estimated precision of ± 3% and an average bias of + 0.8% from the laboratory analyses.

18. C-816 Removal from the Cascade

A procedure was prepared for the removal of C-816 from the cascade using K-301-4 as a side purge and the operation was carried out by Process Operations.

19. Special Gradient Samples

A special sampling manifold has been designed and constructed for the removal of standard samples from the cascade which are relatively free of C-816. This unit which embodies a cold trap for selectively freezing out the C-616, has been tested and a standard procedure prepared for its routine use.

[redacted]

20. Line Recorder Operating Cost

A study was made to determine the cost of operating the thirty-three line recorder stations in the plant. The cost analysis, which included operating, maintenance, materials, and handling costs, showed the total monthly operating expense to be $107,569 or $3260 per station.

21. Function of the Line Recorder

A brief memorandum was prepared covering the functions, limitations, and special applications of the line recorder when used in a gaseous diffusion cascade.

22. Elimination of Section 312

An economic balance has been made to determine the feasibility of carrying out the purging operation in building 306-7 rather than in Section 312. At a product concentration of 412000 it was found that there would be a net gain in productivity if four and one-half cells of 306-7 were used for purging, due to reduced "X" consumption, but the purge losses of "X" would be much higher than at present. Another economic balance in 306-7 of number of cells used versus the "X" concentration in the purge gases indicated that, if 306-7 must be used for purge building, the optimum number of cells to be used would be six. Tests indicate that ten cells would probably be needed to give C-616 concentration in the purge gases the same as is now obtained in 312-1.

23. Direct Recycle Inleakage Checks

In studying the feasibility of installing additional separating equipment in K-27, the question was raised as to whether inverse recycle lines are needed for each cell. At present, one of the chief reasons for putting a cell on inverse recycle is to determine its inleakage. Calculations indicate that inleakage checks could be made with a cell on direct recycle with comparable precision. The apparent inleakage measured in this fashion would be approximately three times the true inleakage.

24. Motor Loads Vs. High Side Pressure

Actual cell loads in kilowatts at various high side pressures have been plotted for all sections but -1, 1, 2b, and 3a.

25. Power Requirements for K-306 at 412000 Operation

A report has been prepared which gives the power requirements in the K-306 section at 412000 operation. The report also considers the feasibility of adding a load of twenty-eight new cells to the K-306 section's electrical equipment.

[redacted]

Reports Issued:

1. "Bias on Unit Consumption Values on Converters No. 234 and No. 236", 1.73.14, C. P. Coughlen, 9-12-46

2. "Progress Report on Operation of Three Types of Carbon Seals on the V. I. W. "T" Pump", 3.2.4, J. C. Posey and B. H. Tollefson, 8-29-46

3. "Evaluation of Dust Burden in Cascade Waste", 3.95.1, R. P. Levey and J. D. Mirkus, 9-5-46

4. "Reactivity Specifications for C-816 in K-25 and K-27", 3.109.1, Carter, Stief, Thomas, 9-13-46

5. "Rates of P. G. Consumption by Metals, Long Range Program", 1.73.15, C. P. Coughlen, 9-30-46

6. "T" Content of Seals Removed from Cascade", 1.73.13, C. P. Coughlen, 9-10-46

7. "C-616 Removal from Process Converters for Consumption Study", 3.98.1, L. C. Olsen, 9-16-46

DISTRIBUTION

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